

Claims

1. A composition comprising

A) a thermoplastic polymer and

B1) a triblock-copolymer of the formula B-C-B; or

B2) a graft copolymer wherein a polymer block B is grafted onto a polymer C to form a comb copolymer of idealized formula C-B(n) wherein n is greater than 2;

wherein

the polymer block B is compatible to the thermoplastic polymer A); and

the polymer block C has a glass transition temperature of at least 20° K below the glass transition temperature of the thermoplastic polymer A);

and the average molecular weight M_w of the triblock-copolymer B1) or grafted comb copolymer B2) is below 50 000.

2. A composition according to claim 1 wherein the thermoplastic polymer A is selected from the group consisting of polyethylene, polypropylene, polystyrene, polyacrylate, polymethacrylate, polyvinylchloride, polyphenyleneoxide, polyvinylacetate, polyamide and polyester

3. A composition according to claim 1 wherein the block polymer C is selected from the group consisting of poly-n-butylacrylate, polyisoprene, polybutadiene, polyethylacrylate, and polysiloxane.

4. A composition according to claim 1 wherein the polymer block B is selected from the group consisting of polyisoprene, polybutadiene, polystyrene polymethacrylate and polyacrylate.

5. A composition according to claim 1 wherein

the thermoplastic polymer A

polystyrene

polystyrene

polystyrene

polystyrene

polystyrene

polyethylene

polypropylene

and the triblock-copolymer B-C-B are

polystyrene-poly-n-butylacrylate-polystyrene,

polystyrene-polyisoprene-polystyrene,

polystyrene-polybutadiene-polystyrene,

polystyrene-polysiloxane-polystyrene,

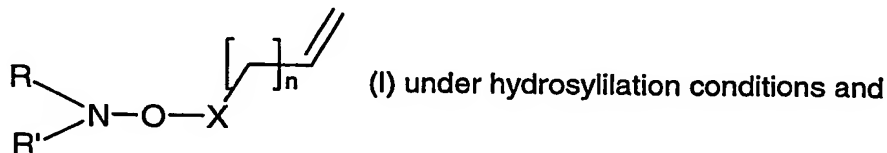
polystyrene-polyethylacrylate-polystyrene,

polyisoprene-polysiloxane-polyisoprene,

polyisoprene-polysiloxane-polyisoprene,

polymethylmethacrylate	polymethylacrylate-polysiloxane-polymethylacrylate,
polyamide	polyethylacrylate-polysiloxane-polyethylacrylate,
polyester	polyethylacrylate-polysiloxane-polyethylacrylate,
polyvinylchloride	polyethylacrylate-polysiloxane-polyethylacrylate,
polyvinylchloride	poly-n-butylacrylate-polysiloxane-poly-n-butylacrylate,
polyphenyleneoxide	polystyrene-polysiloxane-polystyrene or
polyvinylacetate	polymethylacrylate-polysiloxane-polymethylacrylate.

6. A composition according to claim 1 wherein the glass transition temperature of the polymer block C is 50° K below the glass transition temperature of the thermoplastic polymer A.
7. A composition according to claim 1 wherein the average molecular weight M_w of the triblock-copolymer or graft-copolymer is below 30000.
8. A composition according to claim 1 wherein the polymer block C is a polysiloxane.
9. A composition according to claim 1 wherein the triblock-copolymer or graft graft-copolymer is present in an amount of from 0.1 to 10 % by weight, based on the weight of the thermoplastic polymer A).
10. A process for the preparation of a triblock-copolymer or graft graft-copolymer via controlled free radical polymerization comprising the steps of
 - a) reacting a polysiloxane, in the presence of a functional alkoxyamine of formula (I)



- b) reacting the resulting alkoxyamine terminated polysiloxane with an ethylenically unsaturated monomer at a temperature between 60 and 160° C, wherein X represents a group having at least one carbon atom and is such that the free radical

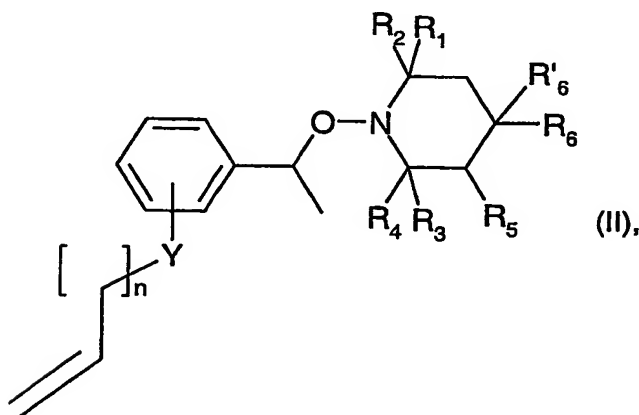


n is a number from 0-18;

R and R' are independently tertiary bound C₄-C₂₈alkyl groups which are unsubstituted or substituted by one or more electron withdrawing groups or by phenyl; or

R and R' together form a 5 or 6 membered heterocyclic ring which is substituted at least by 4 C₁-C₄alkyl groups and which may be interrupted by a further nitrogen or oxygen atom.

11. A process according to claim 10 wherein the functional alkoxyamine is of formula (II)



wherein

Y is a direct bond, O, NH, C(O)O or S;

n is a a number from 0-18.

R₁, R₂, R₃ and R₄ are independently of each other C₁-C₄alkyl;

R₅ is hydrogen or C₁-C₄alkyl;

R'₆ is hydrogen and R₆ is H, OR₁₀, NR₁₀R₁₁, -O-C(O)-R₁₀ or NR₁₁-C(O)-R₁₀;

R₁₀ and R₁₁ independently are hydrogen, C₁-C₁₈alkyl, C₂-C₁₈alkenyl, C₂-C₁₈alkinyl or C₂-C₁₈alkyl which is substituted by at least one hydroxy group or, if R₆ is NR₁₀R₁₁, taken together, form a C₂-C₁₂alkylene bridge or a C₂-C₁₂-alkylene bridge interrupted by at least one O atom; or

R₆ and R'₆ together are both hydrogen, a group =O or =N-O-R₂₀ wherein

R₂₀ is H, straight or branched C₁-C₁₈alkyl, C₃-C₁₈alkenyl or C₃-C₁₈alkinyl, which may be unsubstituted or substituted, by one or more OH, C₁-C₈alkoxy, carboxy, C₁-C₈alkoxycarbonyl; C₅-C₁₂cycloalkyl or C₅-C₁₂cycloalkenyl;

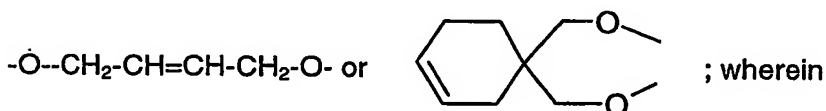
phenyl, C₇-C₉phenylalkyl or naphthyl which may be unsubstituted or substituted by one or more C₁-C₈alkyl, halogen, OH, C₁-C₈alkoxy, carboxy, C₁-C₈alkoxycarbonyl;

-C(O)-C₁-C₃₆alkyl, or an acyl moiety of a α,β -unsaturated carboxylic acid having 3 to 5 carbon atoms or of an aromatic carboxylic acid having 7 to 15 carbon atoms;

-SO₃⁻Q⁺, -PO(O⁻Q⁺)₂, -P(O)(OR₂)₂, -SO₂-R₂, -CO-NH-R₂, -CONH₂, COOR₂, or Si(Me)₃, wherein Q⁺ is H⁺, ammonium or an alkali metal cation; or

R₆ and R₆' are independently -O-C₁-C₁₂alkyl, -O-C₃-C₁₂alkenyl, -O-C₃-C₁₂alkinyl, -O-C₅-C₈cycloalkyl, -O-phenyl, -O-naphthyl, -O-C₇-C₉phenylalkyl; or

R₆ and R₆' together form one of the bivalent groups -O-C(R₂₁)(R₂₂)-CH(R₂₃)-O-, -O-CH(R₂₁)-CH₂₂-C(R₂₂)(R₂₃)-O-, -O-CH(R₂₂)-CH₂-C(R₂₁)(R₂₃)-O-, -O-CH₂-C(R₂₁)(R₂₂)-CH(R₂₃)-O-, -O-o-phenylene-O-, -O-1,2-cyclohexyliden-O-,



R₂₁ is hydrogen, C₁-C₁₂alkyl, COOH, COO-(C₁-C₁₂)alkyl or CH₂OR₂₄;

R₂₂ and R₂₃ are independently hydrogen, methyl ethyl, COOH or COO-(C₁-C₁₂)alkyl; and

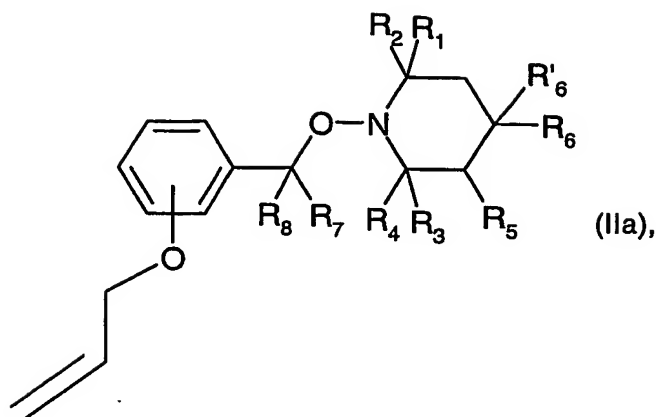
R₂₄ is hydrogen, C₁-C₁₂alkyl, benzyl, or a monovalent acyl residue derived from an aliphatic, cycloaliphatic or aromatic monocarboxylic acid having up to 18 carbon atoms.

12. A triblock-copolymer or graft-copolymer obtained via a controlled free radical polymerization process according to claim 10.

13. A composition according to claim 1 wherein the triblock-copolymer or graft-copolymer is prepared via controlled free radical polymerization according to claim 9.

14. Use of a triblock-copolymer or graft graft-copolymer prepared according to claim 1 as additive for enhancing the melt flow of thermoplastic polymers during processing.

15. A compound of formula IIa



wherein

R_1 , R_2 , R_3 and R_4 are independently of each other C_1 - C_4 alkyl;

R_5 is hydrogen or C_1 - C_4 alkyl;

R'_6 is hydrogen and R_6 is H, OR_{10} , $NR_{10}R_{11}$, $-O-C(O)-R_{10}$ or $NR_{11}-C(O)-R_{10}$;

R_{10} and R_{11} independently are hydrogen, C_1 - C_{18} alkyl, C_2 - C_{18} alkenyl, C_2 - C_{18} alkinyl or C_2 - C_{18} alkyl which is substituted by at least one hydroxy group or, if R_6 is $NR_{10}R_{11}$, taken together, form a C_2 - C_{12} alkylene bridge or a C_2 - C_{12} -alkylene bridge interrupted by at least one O atom; or

R_6 and R'_6 together are both hydrogen, a group $=O$ or $=N-O-R_{20}$ wherein

R_{20} is H, straight or branched C_1 - C_{18} alkyl, C_3 - C_{18} alkenyl or C_3 - C_{18} alkinyl, which may be unsubstituted or substituted, by one or more OH, C_1 - C_8 alkoxy, carboxy, C_1 - C_8 alkoxycarbonyl; C_5 - C_{12} cycloalkyl or C_5 - C_{12} cycloalkenyl;

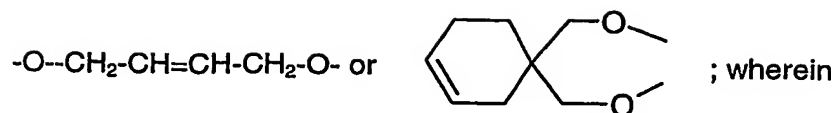
phenyl, C_7 - C_9 phenylalkyl or naphthyl which may be unsubstituted or substituted by one or more C_1 - C_8 alkyl, halogen, OH, C_1 - C_8 alkoxy, carboxy, C_1 - C_8 alkoxycarbonyl;

$-C(O)-C_1-C_{36}$ alkyl, or an acyl moiety of a α,β -unsaturated carboxylic acid having 3 to 5 carbon atoms or of an aromatic carboxylic acid having 7 to 15 carbon atoms;

$-SO_3^-Q^+$, $-PO(O^-Q^+)_2$, $-P(O)(OR_2)_2$, $-SO_2-R_2$, $-CO-NH-R_2$, $-CONH_2$, $COOR_2$, or $Si(Me)_3$, wherein Q^+ is H^+ , ammonium or an alkali metal cation; or

R_6 and R'_6 are independently $-O-C_1-C_{12}$ alkyl, $-O-C_3-C_{12}$ alkenyl, $-O-C_3-C_{12}$ alkinyl, $-O-C_5-C_8$ cycloalkyl, $-O$ -phenyl, $-O$ -naphthyl, $-O-C_7-C_9$ phenylalkyl; or

R_6 and R'_6 together form one of the bivalent groups $-O-C(R_{21})(R_{22})-CH(R_{23})-O-$, $-O-CH(R_{21})-CH_2-C(R_{22})(R_{23})-O-$, $-O-CH(R_{22})-CH_2-C(R_{21})(R_{23})-O-$, $-O-CH_2-C(R_{21})(R_{22})-CH(R_{23})-O-$, $-O-o$ -phenylene- $O-$, $-O$ -1,2-cyclohexyliden- $O-$,



R_{21} is hydrogen, $C_1\text{-}C_{12}$ alkyl, COOH , $\text{COO-(}C_1\text{-}C_{12}\text{)alkyl}$ or $\text{CH}_2\text{OR}_{24}$;

R_{22} and R_{23} are independently hydrogen, methyl ethyl, COOH or $\text{COO-(}C_1\text{-}C_{12}\text{)alkyl}$;

R_{24} is hydrogen, $C_1\text{-}C_{12}$ alkyl, benzyl, or a monovalent acyl residue derived from an aliphatic, cycloaliphatic or aromatic monocarboxylic acid having up to 18 carbon atoms; and

R_7 and R_8 are independently hydrogen or $C_1\text{-}C_{18}$ alkyl.